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Personal Statement: MRI Physics

Primun non nocere is the golden rule of the noble art of medicine. As a researcher in the biomedical and related sciences, a person is able to affect the lives of patients on grand order of magnitude. Researchers in biophysics seek to contribute to a body of literature dedicated to the advancement of healthcare. In doing so, the physicists in these fields are able to permanently alter the course of administration of healthcare. At its roots, biophysics is the epitome of helping those in need, which is chiefly why I have selected magnetic resonance imaging (MRI) physics as my declared area of research.

The concept of MRI has only existed since the middle of the 20th century. The central mechanism behind MRI requires the theory of quantum mechanics. Images of live tissue are able to be taken based on the differences in their properties. The resultant magnetic flux due to the changing of the constituent proton's magnetic moments is different between tissues, allowing anomalies such as cancer to be detected. This background leads to a study by Yablonskiy and Haacke[i] which is the root of the research I would like to conduct. In the study, Yablonskiy and Haacke examined the relationship between nuclear magnetic resonance signals (NMR) in some tissues such as blood vessels and lung bronchiole networks. This study lead to a body of literature employing this tactic to interpret the NMR signals generated in this manner. With this stated, I wish to extend upon this research, performing clinical trials in patients who need tissues such as these imaged, for the purpose of diagnosis or monitoring.

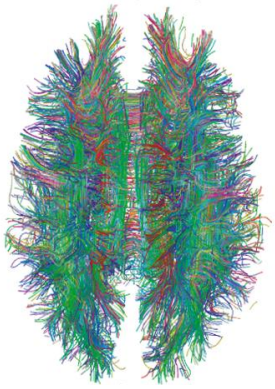

Figure 1: This figure shows the imaging of the white matter connections in the brain. While this image shows no pathology, studies like it can be used to diagnose and treat disease in patients.

I wish to expand upon this research by improving contrasts in MRI studies. Presently, computed tomography (CT) offers advantages in three-dimensional analysis of patient tissues and diagnostics. While CT studies are highly beneficial, the ionic CT contrast used is both nephrotoxic and radioactive. The risks are small to a healthy patient, but MRI is consistently safer for those who do not have MRI-sensitive hardware. I wish to help develop the usage of images produced from MRI such as those in Figure 1.[ii] Through this, I believe that CT will see a decline and usage in the name of increasing patient safety, and changing the course of disease management for the better.

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[i] Yablonskiy, D. A., & Haacke, E. M. (1994). Theory of NMR signal behavior in magnetically inhomogeneous tissues: the static dephasing regime. *Magnetic resonance in medicine: official journal of the Society of Magnetic Resonance in Medicine / Society of Magnetic Resonance in Medicine*, *32*(6), 749–763.

[ii] User:Was a bee. (2013). *White Matter Connections Obtained with MRI Tractography*. Retrieved from http://upload.wikimedia.org/wikipedia/commons/f/f2/White_Matter_Connections_Obtained_with_MRI_Tractography.png